Exercise machines come in various forms. The most popular type of exercise machines currently include the Nautilus system (a system using weight blocks and cams to exercise various specific muscle groups on specialized machines) and exercising machines such as air fan resistance stationary bicycles like the RANDALL WIND RACER, air fan resistance stationary rowing machine like the CONCEPT II ERGOMETER, and electric resistance climbing machine like the STAIRMASTER (devices that exercise more general muscle groupings and provide aerobic conditioning). Although some of the exercising machines can utilize variable loadings, these loadings are normally only the machines preprogrammed workout levels. The consumer must therefore normally accept the exercising of specialized muscles bidirectionally (resistance machines like NAUTILUS machines), or a more complete general workout without bidirectionally or much individual control (the other named machines).

SPECIFICATION PAGE 1 PARAGRAPH 2

This invention relates to an improved exercising machine. A generic description of a preferred embodiment of the invention is shown in Figure 7. In this figure there is a repetitive input of force 10 into a controllable variable resistance 11. The repetitive force 10 may or may not be bidirectional depending upon the particular muscle group being exercised. For example with a bicycle machine having pedal input as the repetitive force 10, the repetitive force 10 would be the unidirectional pedalling force occasioned by the exerciser. However if the force 10 was resultant from a back press resistance machine, the force would be bidirectional--a positive force when the exerciser moves his back against the resistance (weights) and the negative force which occurs as the exerciser returns to his original position holding back against the now positive force of the previous resistance. The controllable variable resistance 11 takes the force 10 and utilizes it by driving or moving a load 12. Preferably this load has an inertial quality to it. This would provide the exerciser with an additional personally controlled parameter that can be manipulated independently of the machine (if desired). For example a resistance exerciser like a NAUTILUS machine incorporating this additional parameter would allow the exerciser to accomplish the exercise repetition quickly at a high but uneven effort or more slowly at a lower but even effort (while retaining the same overall time per repetition). Note that since it is

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easier to work against a reducing resistance, it is preferred that the machine be initially set for a high resistance in an automatic universal mode, reducing it as necessary to match the exerciser (beginning with a lower resistance, although harder to control, may be more satisfying to some users who need to feel a sense of accomplishment early on). In the embodiment of Figure 7 the load 12 is a preset inertial fan having both flywheel and resistance capabilities. This particular load is suitable most specially for a unidirectional force such as that produced by a bicycle machine having a pedal input. With other types of exercising equipment, other loads might be selected (such as variable resistances, weights, flywheels, springs, motors, etc.). (Note that in the instance of a bidirectional force combined with an inertial type load it may be desirable to install a reverse drive mechanism and a forward/reverse clutch or some kind of a reverse load, such as a motor, into the resistance 11 such that power or resistance can be returned to the exerciser on the return stroke--for example in a manner similar as occurs with the weights of an exercising machine like in the NAUTILUS system.)

SPECIFICATION PAGE 4 PARAGRAPH 1

In an added refinement of the concept of Figure 7, an altering mechanism 14 would be utilized interconnected to the controllable variable resistance 11 on load 12 to directly alter the base line of the exercise. This would be especially helpful if the load for the controllable variable resistance 11 was itself relatively non-adjustable. An example of this would be if the load was a non-adjustable weight stack in a NAUTILUS machine or other not easily changed resistance. The altering mechanism 14 would preferably be under the control of the control mechanism 13 to provide an additional variable parameter by a control line 15 for the controllable variable resistance 11. This altering mechanism 14 could be utilized as a feedback mechanism for the force 10, it could be utilized to modify the load for the exerciser at particular moments in the exercise cycle, or otherwise utilized as appropriate. An example of this motor could be utilized as an altering

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mechanism 14 to reduce (or increase) the effective resistance felt by the exerciser at various points during the exercise cycle. This example would allow the machine to provide a varying load with an otherwise constant resistance by effectively using the motor to add to or subtract from such resistance--i.e. to vary the resistance over time in a predetermined manner. This would allow an individual to change the exercise parameters of an exercising machine like a NAUTILUS machine, for example to feature one specific muscle over another muscle or to vary the resistance curve set by the cams in the machine. It would also allow an override should, for example, the machine move too quickly at high settings (i.e. the exerciser has difficulties with a return stroke) or too slowly at any setting (i.e. the exerciser has set the machine load himself but with too much weight). The various parameters of alteration could be set individually or be programmed in. The motor could also be utilized in conjunction with a sensor to match the workout with certain preset parameters. An example of this would be for the motor to increase (or reduce) an otherwise constant resistance to maintain the exerciser's heart rate within certain preset limits--i.e. to maintain the period of an exerciser's accomplishment of a repetitive task within the predetermined limits of a certain parameter or set of parameters. (Whether such task is the time to move a 100 pound weight one foot or to move the pedal of a bike one revolution). Note that if the control box 13 is programmed with a time per movement or repetition or other such relatively known or

determinable parameter as a primary factor, it would be possible to provide for many users with but one setting. For example with the

SPECIFICATION PAGE 7 PARAGRAPH 1

Although the resistance once set could thereafter remain constant for the particular exerciser, the machine would preferably alter this resistance continually through the ongoing exercise to enable the exerciser to maintain the workout within the designated parameters (in the example instance with time as a parameter normally reduce the resistance as the exerciser tires during successive repetitions). A feedback indicator 16 (a series of lights or a changing tone for example) would inform the exerciser of his or her success in maintaining the desired rate of exercise (in the example instance, the four second repetition rate). An analog feedback is preferred for being easier to comprehend. Note that the exercise parameters could also be varied over time--in the example instance beginning with a rate of four seconds per repetition and end at a rate of sixteen seconds per repetition (i.e. tired exerciser), or beginning with the resistance needed to produce four seconds per repetition and ending with a 250 pound resistance (hard to do). This would be particularly pertinent to an exercise machine using resistances (as in a NAUTILUS machine) incorporating the invention as this increasing time is a natural phenomenon repetitive exercise as in a NAUTILUS machine. Thus both the nature and amount of measurement could be varied if desired. (Note, however, that the use of a single preset measurement and/or quality of exercise provides a simplicity and universality of use--i.e. the machine would need no setup to accommodate many different users.)

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machine. For example in order to retain a particular exerciser's time per repetition to be constant on a NAUTILUS resistance exercise machine. The resistance is therefore varied to accomplish this. Note that the inclusion of other factors (such as inertia into a machine) would provide additional variables (such as the difference of speed of the applied force between successive routines) to the actual programming.

SPECIFICATION PAGE 11 PARAGRAPH 1

The preferred embodiment of the invention can be used with preexisting resistance exercise equipment, a NAUTILUS machine for example, by incorporating a sprocket 29 on the end of the bidirectional input shaft 20 and connecting such sprocket 29 to the customary chain 30 from the NAUTILUS equipment (shown in Figures 4 and 5). In the event of an unidirectional force on the chain 30 (with the usual return spring 31), the control circuit 23 would preferably disconnect the generator 21 and feedback motor 22 from the shaft 20 so that there is no load on the return cycle against which the spring 31 must act. In the event of a bidirectional force on the chain 30, both sides of the chain would be normally active such that no return spring 31 would be necessary. In the preferred embodiment of this adaptation the resistance is provided by the NAUTILUS weights already in place on the machine. For this reason the feedback 22 and resistance 24 drive functions can be combined into a single motor. This motor is utilized to alter the resistance already in place by adding to or subtracting therefrom as previously discussed. the retention of the existing NAUTILUS weights has the advantage of allowing individual settings by hand if preferred by a particular exerciser. In keeping with the philosophy of a NAUTILUS machine, it is envisioned that the major application for the invention in such machines would be to alter the

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As Shown in Figures 2 and 3, the invention can be also utilized in specially designed equipment. This incorporation has the added advantages of small size in respect to existing exercise resistance NAUTILUS equipment. The particular configuration shown in Figures 2 and 3 is a rotary abdominal machine. In this machine a user sits on the seat 33 with his/her arms wrapped behind the two bent shaped arm pieces 34, 35. As the user rotates his/her upper body about the axis of the shaft 20, the shaft 20 is in turn rotated in a bidirectional manner to provide the input force for the loading and feedback mechanism of the invention of this present application. Note that the rotational axis of the shaft 20 of this particular machine is in line with the exerciser's spine. Note also that this particular incorporation of the invention provides other benefits as well. For example in the present NAUTILUS abdominal machine the user works against a constant weight load during each direction of rotation. The preferred NAUTILUS device of Figures 2 and 3 selectively provides for this and more. For example one can program the control box 23 to provide for an inertial quality. With this quality the exerciser would feel as if the machine was interconnected to a flywheel--i.e. the speed (and force) of an exerciser's movements would have a marked effect on the quality of exercise (by effectively allowing the exerciser to spread the resistance over any length of time at his/her option). This would enable one to have an aerobic exercise utilizing a unique muscle

group toning the muscle more expeditiously than NAUTILUS could in the NAUTILUS type equipment. It

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would also allow one to exercise a muscle group longer than within a NAUTILUS machine. Therefore in addition to altering the resistance, the invention also allows other benefits as well.

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ordinary use the feedback motor 102 may be preset to establish a certain preload on the input shaft 120. An example of this preload would be a constant 100 pound reverse force. The individual who manipulated the input shaft would therefore have to overcome this force in the manipulation of the input shaft. The generator 101 would inform the central processing unit 109 of the speed and ease at which the user was successful in overcoming this constant force applied by the feedback motor. If the individual was working too quickly, the central processing unit 109 would increase the load. If on the other hand, the individual was having too tough a time, the central processing unit 109 would reduce the load. Examples of this have been previously described. The load modification could be occasioned by removing/adding to the generator's effective load, or by supplementing/detracting from the power going to the motor, or by changing the ballast. The former is preferred as being the most expeditious. Again if desired a direct mechanical connection 201 can be established between the input shaft 120 and shaft 200 driving the load 107. This would be appropriate, for example, in the case of exercise equipment such as a NAUTILUS machine. Note that with a direct mechanical connection to a load, the feedback motor 102 can be combined with the drive motor 106 (and even the generator 101 with appropriate modifications such as a torque differential sensor between the shaft 120 and 200) to either add to or detract from the effective load on the shaft 120 as necessary (i.e. the modification of the effective force provides both functions). Other examples of

how the central processing unit 109 would control the apparatus of Figure 1 has been previously described

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